UDC 551.577.37(742)"1966.08.02"

WEATHER NOTE

Remarkable Point Rainfall at Greenfield, N.H., Evening of August 2, 1966

R. E. LAUTZENHEISER
ESSA State Climatologist, Boston, Mass.
A. E. ROTHOVIUS
Weather Bureau Cooperative Observer, Milford, N.H.
J. R. SIMS
Office of State Climatologist, Boston, Mass.

1. INTRODUCTION

An excessive rain of amazingly small areal extent fell late on Aug. 2, 1966, at Greenfield, N.H. This note describes the storm, presents related storm statistics, reviews briefly the synoptic situation, and mentions the danger of interpreting point rainfall data as being representative of an area.

2. THE GREENFIELD STORM

Mr. Robert H. Stanley, of Pine Ridge Road, Greenfield (fig. 1), in southern New Hamphire, reported a remarkable rainstorm occurring late on Aug. 2, 1966. A total of 5.75 in. was measured in a V-type plastic gage of 6-in. capacity. This type of gage is of reasonable accuracy in comparison with standard ESSA-Weather Bureau standard rain gages (Huff 1956). Mr. Stanley has observed weather for many years and is conscientious about the accuracy of his records. While 5.75 in. may not be an exact figure, it is believed to be substantially correct.

Mr. Stanley's locale is 1.5 mi northeast of Greenfield, of about 900 ft. at an elevation above sea level It is situated on the southern slope of a gentle ridge running generally east-west and lies about 2.4 mi south-southeast of Crotched Mountain, which has peaks with elevations just over 2,000 ft.

Rain began at about 1900 EST, or about an hour before the outbreak of more generalized showers in the region. It soon became a downpour, continuing until about 2300 EST, at which time Mr. Stanley went to bed. It was then still raining, but had slackened noticeably. The rain may have stopped by midnight. A remarkable nonvariability of the intense rain was noted by Mr. Stanley. There was very little slackening, even for brief intervals, during the period of heaviest fall, which was from about 1945 to 2215 EST. There was practically no wind. Neither thunder nor lightning was observed. The noise on the roof was terrific, like that of a continuous waterfall. A

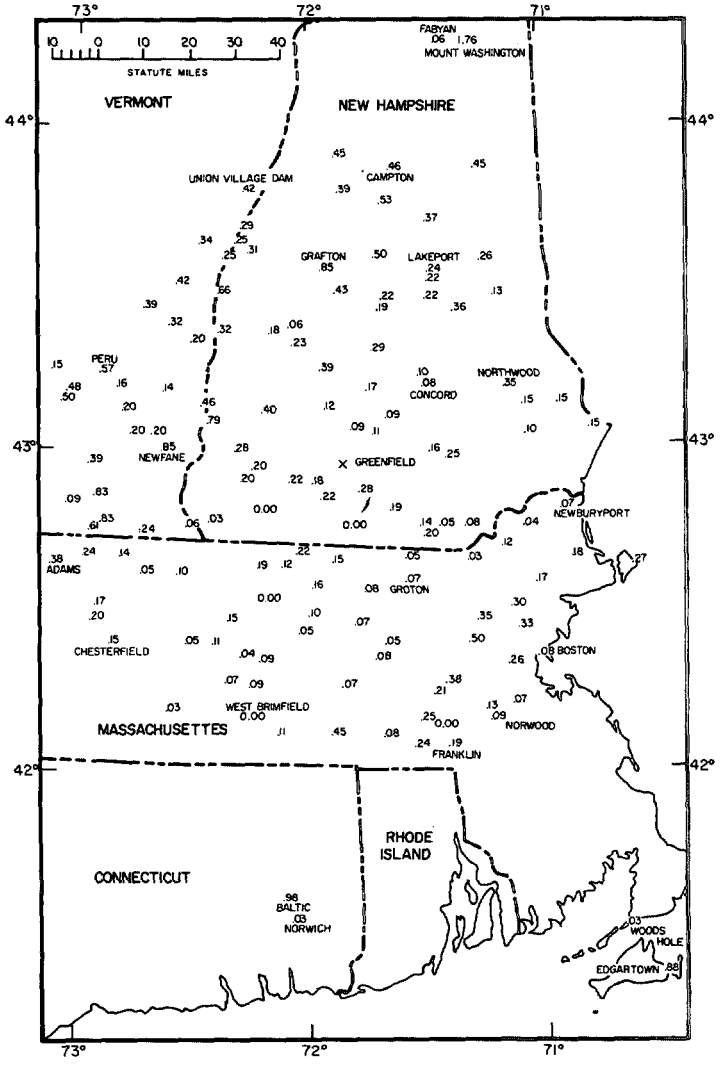

FIGURE 1.—Rainfall (inches) for the Greenfield, N.H., area on Aug. 2, 1966. Each decimal point also marks the site of a reporting station.

plastic bird feeder mounted on the side of the house was broken by the impact of sheets of water from the eaves. Looking out the window, Mr. Stanley could see stones and gravel from the roadway, south of the house, being washed away by torrents of water.

Upon rising in the morning, Mr. Stanley noted that the weather had cleared, with a brisk westerly wind. After finding the 5.75 in. of rain in the gage, he inquired from a neighbor 0.3 mi to the east. He found that the neighbor had but 0.50 in. in his gage. He thereupon examined the countryside for visible effects. The road washout extended for only a few hundred feet. Upon going one-half mile in either direction, no evidence of rain erosion of sand or gravel could be found. South of the house, beginning at the gage which was mounted on a pole, well distant from structures or trees, there stretches a 10-acre field. The knee-high grass therein was beaten down flat. By afternoon it began to revive. By the following noon it was erect. To the west of the house, a dry-wash brook running bankful at dawn was empty by 0800 EST.

Drawing a line around the traces of erosion, one obtains an oval area about a mile north-south and about three-fourths of a mile east-west. Within this area, rain varied from the order of 1 in. on the limits to almost 6 in. in the center. Outside this limit, rain is believed to have fallen off sharply to less than one-fourth of an inch, generally within a few thousand feet.

3. RAINFALL ELSEWHERE

Rainfall yields were quite spotty over New England, typical of showers, in this August 2–3 period (fig. 1). The greatest reported at any official station was 1.76 in. at the summit of Mount Washington, N.H. The only other value exceeding 1 in. was at Ft. Kent, Maine, where 1.17 in. fell. Large variations in short distances were common. Although near Mt. Washington, Fabyan got only 0.06 in. Baltic, Conn., reported 0.98 in., while nearby Norwich had but 0.03 in. Edgartown, Mass., had 0.88 in., while nearby Woods Hole received only 0.03 in. The accompanying map primarily shows rainfall totals for an area within approximately 60 mi of Greenfield. Totals within this area from the regularly reporting stations varied from 0.85 in. at Grafton, N.H., and at Newfane, Vt., to none at several stations. It may be noted that a reported value of no precipitation does not necessarily mean that no rain fell. With but one daily observation, especially in the summer, a small but measurable amount may occur unseen, then completely evaporate from the gage before the next observation time. For the 20 stations within about 20 mi of Greenfield, the average yield was only 0.19 in., with individual values ranging from none to only 0.42 in. Rainfall yields elsewhere in New England were mostly similar. However, extreme northern areas averaged slightly greater yields, with fewer stations reporting none.

4. COMPARISON WITH PREVIOUS HEAVY RAINS

The localized Greenfield cloudburst does not challenge world point rainfall records, such as the 12 in. in 42 min at Holt, Mo., on June 22, 1947, or the 30.8 in. in 4½ hr at Smethport, Pa., on July 18, 1942 (Paulhus 1965). Yet it appears unique for New England on the counts of extreme localization and sustained, seemingly nonvarying, heavy rate of fall. The nearest comparable record for New England appears to be that at Island Falls, Maine, on Aug. 28, 1959, with 6.35 in. in 3 hr (Lautzenheiser and Fay 1966). The heavy rains extended over an area of more than 8 sq mi, however, in the Island Falls storm. In common with the Island Falls case, this cloudburst occurred with no especially remarkable total falling at any cooperative or first order Weather Bureau station. In either case, one or more stations within 20 mi reported no rainfall.

The heavy rains at Baldwin, Maine, of Aug. 21, 1939, were estimated at up to 12 in. in about 3 hr (Stackpole 1946). However, the Baldwin case was associated with a tropical disturbance, with heavy rains common over much of New England.

Nearly 5 in. must have fallen at Greenfield in the 2½ hr of excessive rates. This averages 2.0 in. per hour, a rate in excess of any calculated for this duration in a 100-yr period for any first order station in the northern United States included in *Technical Paper* No. 25 (U.S. Weather Bureau 1955). This rate is also approximately 150 percent of the greatest value to be expected once in 100 yr as read from the atlas maps of *Technical Paper* No. 40 (U.S. Weather Bureau 1961).

The Greenfield storm total nearly equaled the official 24-hr record for the Concord, N.H., first order station, beginning in 1902.

5. SYNOPTIC SITUATION

The surface chart for August 2, 0100 EST (fig. 2) showed a closed Low (1004 mb) over lower Michigan moving east-northeast, another Low (1007 mb) over southern Quebec, and a third Low (1007 mb) over eastern Quebec. All three were associated with a stationary front that ran from the Maritimes area and eastern Quebec southwestward to the Lake Huron area where it became a cold front running southwestward to Missouri. By August 3, 0100 EST (fig. 3), the surface chart showed that the waves had resolved themselves into a deepened and well-defined low-pressure area (996 mb) located just north of the city of Quebec, with a cold front running on a line from just north of the city to Portland and Boston, and then southwestward. The track of the Quebec storm was down the St. Lawrence River.

The August 1, 1900 EST, 850-mb chart (fig. 4) showed a warm moist tongue of air (15°C) extending up along the coast from about Hatteras to Old Town, around to Albany, and then southwestward to West Virginia. By August 2, 1900 EST (fig. 5), this tongue was moving

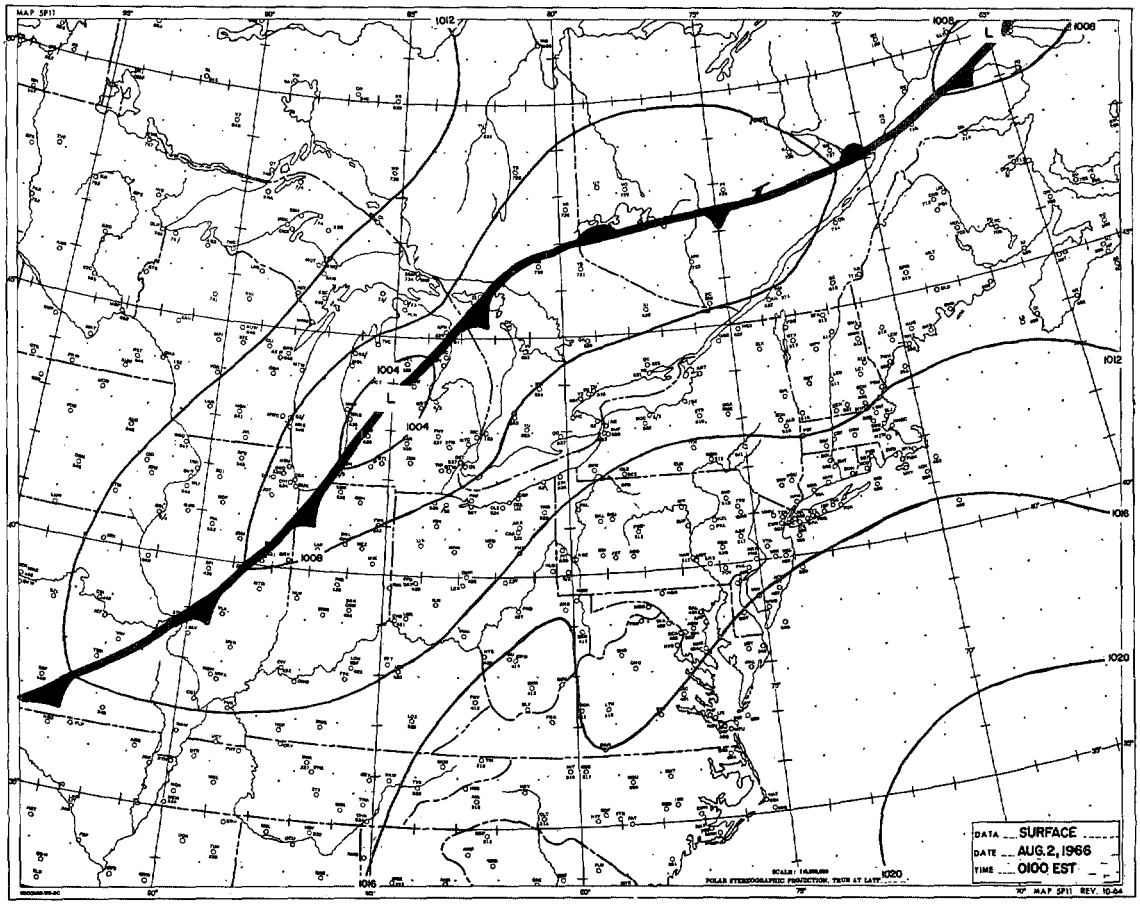

FIGURE 2.—Surface isobars and fronts at 0100 EST on Aug. 2, 1966.

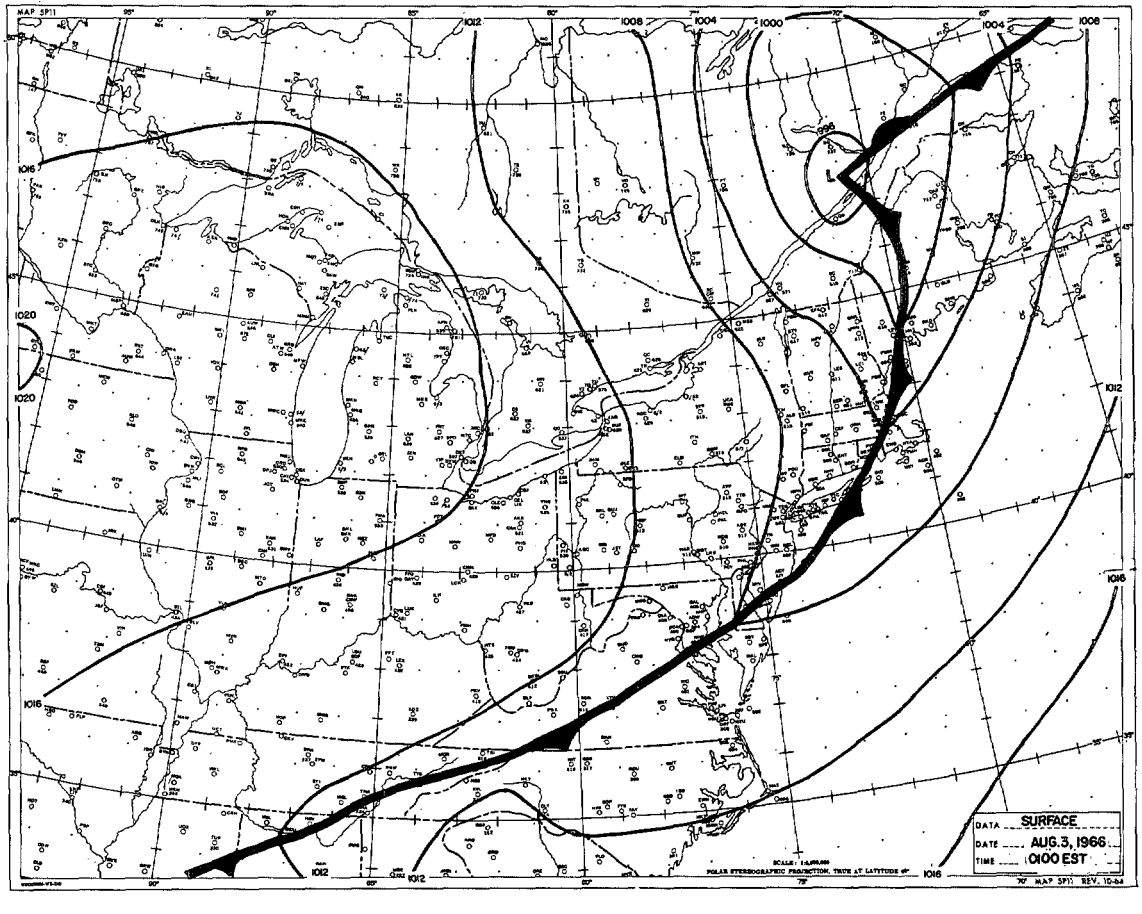

FIGURE 3.—Same as figure 2, except for Aug. 3, 1966.

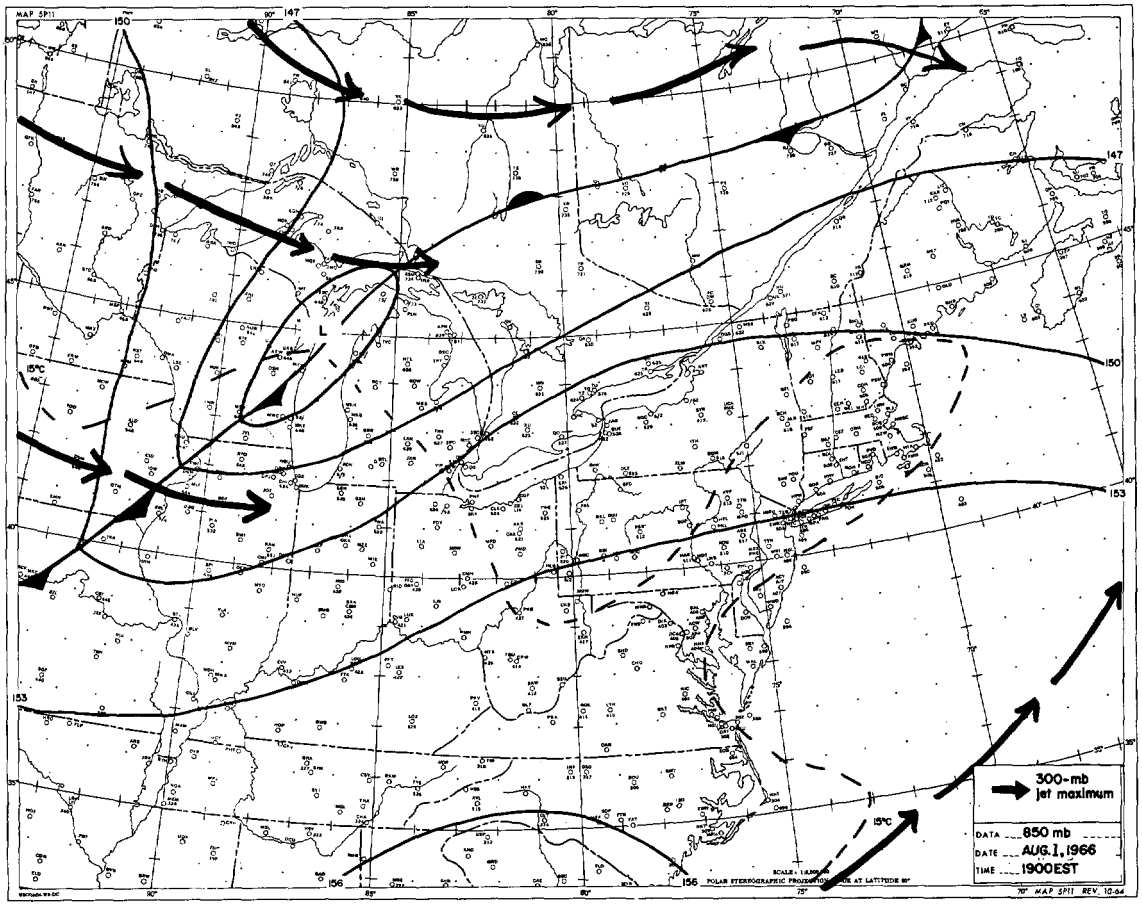

FIGURE 4.—The 850-mb chart at 1900 EST on Aug. 1, 1966. Contours are labeled in tens of meters, isotherms in °C; arrows indicate the 300-mb jet maximum.

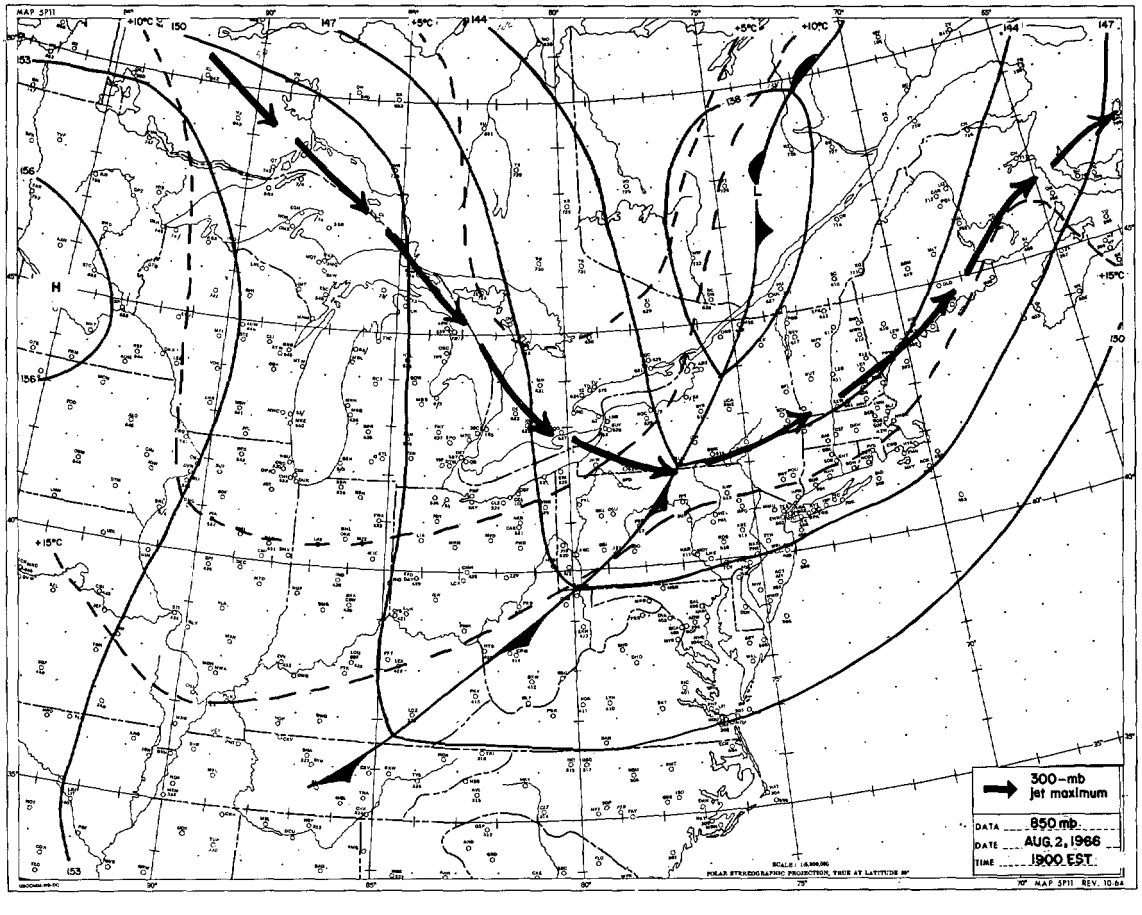

FIGURE 5.—Same as figure 4, except for Aug. 2, 1966.

eastward as a cooler tongue extending from a Low over southern Hudson Bay was pushing into the New England area.

The August 1, 1900 EST, 300-mb chart showed several high-level jets scattered across the country. One from the southern part of Hudson Bay extended to just north of Maine. Another jet ran from northern Florida to the Maritimes, about 200–300 mi off the coast. By August 2, 1900 EST, these jets merged into one jet from the Great Lakes, where a maximum wind core was located, to southern New Hampshire, over Portland, and out over the Maritimes. By the evening of the 3d, the maximum wind core was centered over New England.

At most of the upper levels on August 2, 1900 EST, a trough of low pressure was extending southeastward from a Low over the southern part of Hudson Bay. Throughout the prior period, this trough was forming.

The characteristics of the frontal passage were: winds veering sharply south-southwest to northwest, relatively weak temperature gradient (10°F temperature drop in 200 mi), but a strong dew-point gradient (7°–10°F drop in 50 mi).

The affected area is in the lee of several mountains. Riehl et al. (1964) states that precipitation associated with the jet stream tends to be localized, deviating from the Norwegian models. This precipitation may be associated with small waves that, according to Riehl, develop in the lee of mountains. The superposition of a wind jet and cold front also favors great instability and wave formations. The excessive spot rainfall may possibly be attributed to a wave formed under the influence of these factors.

6. CONCLUDING REMARKS

This unusual rainfall incident at Greenfield, N.H., illustrates a mesoscale problem. The fact that similar situations are not more commonly reported is probably due to low-density precipitation networks (Ostby et al. 1969). Meteorologists are aware of the random nature of summer storms and the resulting large variations of local precipitation; but lack of sufficient data tends to cause point measurements to be applied to relatively large areas. The Greenfield, N.H., storm dramatically points up the danger in interpreting point rainfall data as representative of an area.

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[*Received August 6, 1969; revised September 8, 1969*]